

EL SALVADOR: GEOHERMAL DEVELOPMENT



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El Salvador is the world leader in terms of the percentage of its electricity output from sustainable geothermal resources (24%-26%). The regulator, Superintendencia General de Electricidad y Telecomunicaciones (SIGET), helps to facilitate the success of the geothermal market by ensuring sound regulation and monitoring of the project evaluation process to further the dual objectives of sustainability and energy security. This profile looks at how geothermal competes in the energy market and the steps taken by SIGET to ensure a sustainable and predictable regulatory framework for renewable energy through examination of the illustrative example of the 9.2 MW Binary Cycle Geothermal Plant in Berlin, El Salvador.

The Market for Geothermal Energy

In the mid 90's El Salvador began a process of modernizing the public sector, which facilitated the creation of a competitive model of free access to the various activities of the electricity industry, freeing prices of power generation and setting regulations for transmission and distribution. The country has developed a legal and institutional framework that seeks to promote competition and the necessary conditions to ensure the availability of an efficient energy supply able to meet demand while complying with appropriate technical, social, economic, environmental and financial viability criteria.

In November 2007, El Salvador adopted the Law on Tax Incentives for Renewable Energy Development. This new legal framework includes incentives such as tax exemption for ten years for projects under 10 MW of generating capacity. The exemption applies to expenses necessary for research, exploration and preparation of power generation projects based on renewable energy, and projects of total reinjection of the geothermal resource, for projects over 20 MW. A new System for Renewable Energy Development provides for the creation of a Revolving Fund for the Promotion of Renewable Energy to support loans, guarantees and assistance to finance feasibility studies for new projects.

At present, the legal framework for the El Salvadoran electricity sector is made up of the following legislative and regulatory orders:

- Law creating the regulator was issued by Legislative Decree No. 808 of 12 September 1996
- General Electricity Law, issued by Legislative Decree No. 843 of 10 October 1996
- Electricity Law Regulations, established by Executive Decree No. 70 of 25 July 1997, including amendments thereto
- Electric Power Marketing Activities Regulations, issued on 24 October 2000, which aims to promote competition in energy market

- Amendment to the General Electricity Law, issued by Legislative Decree No. 1216, dated 11 April 2003
- The Legislative Decree No. 405 of 30 August 2007

The Salvadoran Wholesale Electricity Market allows all Market Participants with a direct connection to the transmission system (115,000 volts and over) to participate in energy transactions. These participants may be generators (>5 MW), distributors or end users. Agents with no connection to the transmission network also may participate indirectly in the market, as traders, pursuant to special regulations developed by SIGET.

A look at the energy sector's overall market and structure is important to understand the importance of geothermal energy operation and development in El Salvador. The overall installed electrical power generation capacity reported by the end of 2008 was 1,422.2 MW supplemented by 2% imported power. Peak demand was 924 MW and yearly demand was 5,475 GWh, an increase of 4.06% over the reported value of 5,261.7 GWh in 2007.ⁱ 2009 data shows El Salvador produced 2,524 GWh from oil and 1,501 GWh from hydro.ⁱⁱ Geothermal sources provided 1,421 GWh, representing approximately 25.5% of overall generation.ⁱⁱⁱ Notably, the government has significantly increased investment spending in the electricity sector in recent years. As a result, households with access to electricity nationwide have increased from 70% coverage in 1999 to almost 88% in 2005, and finally to 91% in 2009.^{iv}

The country's abundant geothermal resources, combined with the scarcity of other domestic energy resources and a population of 6.5 million, make the Central American country a particularly appropriate location to develop geothermal power.^v Exploration for geothermal energy sources began in the 1950's and 1960's with the assistance of the United Nations. Two geothermal fields currently include operating plants: Ahuachapán and Berlin, with a total installed operating capacity of over 200 MW. Exploration is ongoing in two other fields: San Vicente and Chinameca.^{vi}

The electricity market in El Salvador was liberalized in 1998, with thermal generation and distribution sold to foreign investors, readying the environment for additional investment in all sectors, including geothermal. CEL, the state-owned energy company, kept the hydropower facilities, and geothermal was spun off and given to what is now LaGeo, a private-public Italian joint venture geothermal power generation company. Transmission was also spun off from CEL. With respect to the electricity generation sector, market participants include: (1) CEL; (2) one US investor that bought three thermal generation plants from CEL in 1999; (3) an Indian-Israeli consortium that recently bought a thermal power plant from a British company; and (4) LaGeo. As a result, geothermal financially competes in an open power market. The number of plants, amount of energy produced, and the share of total energy production for geothermal continue to grow.

The Regulatory Role: the 9.2 MW Binary Cycle Project in Berlin

SIGET is responsible for promoting competition, overseeing compliance with the General Law on Electricity, approving tariffs, granting concessions, resolving sector conflicts and regulating procedures, technical standards and methods. As such, SIGET supervises the development of

power generation projects using geothermal resources. The regulator monitors project evaluation in order to ensure use of sustainable resources and is responsible for ensuring that clear and transparent rules are adopted and implemented fairly and that concessions are granted in a non-discriminatory manner and in compliance with the Electricity Law.

When the electricity market reformation began in El Salvador under the Electricity Law of 1996 geothermal assets were spun off of the formerly vertically integrated state-owned monopoly (CEL) to a new company, GESAL formed in 1999. GESAL was later renamed LaGeo, S.A. de C.V. (La Geo). The Italian company, Enel Green Power, originally invested in LaGeo in 2002 and then increased its share from 12.5% to 36.2% in 2008 with CEL owning the remaining portion.

In Berlin, the first exploratory well (TR-1) was drilled in 1968, and operations began in the Berlin field in 1992 with two small (5 MW each) plants, financed with Belgian assistance. The original installations were followed by 56 MW in 1996 and were financed by CEL with support from the Inter-American Development. The Berlin field was further expanded by 44 MW (Berlin III) by LaGeo, a public-private company, in 2007. The 9.2 MW Binary Cycle Project initiated in 2004 builds on these previous studies and infrastructure at the Berlin site.

The Berlin binary plant was engineered under an Engineering, Procurement, Construction Management contract awarded to Enx, an Icelandic firm. It uses convection Organic Rankine Cycle technology, which utilizes an organic, high molecular mass fluid with a boiling point at a lower temperature than the conventional water-steam phase change. The working fluid flows in a closed loop and is circulated and re-used constantly. A binary plant enables 100% re-injection of the geothermal brine, which maintains the sustainability of the reservoir. After a two-year service guarantee period, the facility now operates at a net capacity of 7.8 MW.

Initiating the Project: Application and Approval. As was the case with the Berlin binary plant, the regulator's role in projects begins at the outset. The Electricity Law provides that an operator of geothermal fields wishing to increase the installed capacity must apply for authorization from SIGET. The Berlin binary project represents an expansion of the installed capacity in the concession area of the Berlin Geothermal Field with the addition of Unit IV to the existing units. This expansion required that a permit be obtained from SIGET. The application procedure requires that:

- The investor (concessionary) must conduct a feasibility study with all its components: technical description, location, investment costs, resources to be used, environmental permit, etc.
- The concessionary submits an application, together with a feasibility study of the additional capacity to be installed, detailing all the technical, economic and financial information, as well as the respective environmental permit.
- The regulator evaluates the application and verifies the sustainable use of the resource, issuing a technical opinion regarding the project viability. The extent and nature of the regulator's evaluation depends on the size of the project. In the case of the binary cycle, SIGET's staff has the capacity to evaluate the project

and issue a technical report recommending its approval. If the project requires a higher level of expertise, an international expert (consultant) is hired to advise SIGET during the evaluation of the feasibility study.

- Upon a positive finding in the technical evaluation SIGET authorizes via a resolution, the amendment to the concession contract.

There is no legal time limit for this expansion application process. If the feasibility study is fully complete and the investor has prepared the application in full, the process can take as little as 15 working days for the concession to be extended and renewed. If an expert is needed to evaluate the project to support SIGET, the process can take up to three months due to the hiring process.

If a project is to be constructed outside the established concession area, it must seek approval from SIGET for a license or permit to use the geothermal resource. In this case, the processing time is two to four months for projects with an installed capacity of less than 5 MW, and five months for projects with a capacity greater than 5 MW.^{vii} This delay, while not an issue in the Berlin binary project, can prove burdensome for investors seeking new concessions and is recognized as a barrier in need of attention.

Monitoring. After an application is approved, SIGET has a leading monitoring role:

- During the construction phase, the concessionaire shall annually report on the information necessary to track the project. SIGET reviews, evaluates and follows up on these reports
- In the operation stage, the concessionaire must report data annually for the operation of the field, expansion and improvement projects, and all information that guarantees the efficient use of the resource. SIGET reviews, evaluates and follows up on these reports
- At project closure, the concession contract establishes that the concessionaire will have a period of twelve months for the removal of their property and restore the environment in accordance with the specifications for the abandonment phase of the project, which is part of the contract concession. SIGET verifies compliance with the contract

Developing Rules of Operation and Market Regulations. Looking first at the underlying regulations in support of geothermal production in El Salvador, the most important rules for operation of the sector include Rules for the Transmission System Operation and Wholesale Market Regulations, both first approved by the regulator in 1999. These regulations set out the conditions for dispatch of all power resources available in El Salvador. Geothermal competes with thermal generators, hydropower and imports with no subsidies and is paid either by contract or at market prices. Historically, LaGeo's price bid into the market has been the lowest so all available geothermal power has been dispatched first. As regards information management, energy management, restricted energy supply and mandatory generation systems, even though market variations are based on cost, these do not affect the operation of Unit IV.

To begin the operation of Unit IV, appropriate arrangements were made for both the incorporation of the unit into the transmission system, operated by the Transactions Unit, S.A. of C.V. which manages the Wholesale Energy Market, and the contract for interconnection to the transmission network with the Transmission Company of El Salvador, S.A. of C.V.

To improve the operating rules of the wholesale market in July 2009 SIGET approved the publication of the Production Cost-Based Transmission System Operation and Wholesale Market Regulations, which come into effect in early 2011. Accordingly, there have been significant changes to the Transmission System Operation and Wholesale Market Regulations, including the information management and energy management system, Restricted Power Bids and Mandatory Generation, and the Transient Transfer Mechanism of energy price to end user rates. The latter establishes the conditions to be met by generators of any type of resource (geothermal, hydroelectric, cogeneration and thermal) in order to allow participation in the dispatch of the Wholesale Market.

Because LaGeo's price has historically been the lowest bid into the market, the improved rules have not directly affected the Berlin binary plant. However, the improved operating rules for the wholesale market do create investor friendly conditions for new renewable power. The new cost-based scheme allows for payment for installed power capacity, thus guaranteeing a return on investment and allowing the investor to sell energy in the spot or opportunity market at a marginal cost.

Oversight of the Concession Process. The regulator is closely engaged in the concession process, with responsibility for granting a permanent concession. In compliance with the provisions in Article 120 of the General Electricity Law for granting concessions to companies resulting from the restructuring of CEL and the ruling No. 14-E-2000 dated 27 March 2000, SIGET granted a permanent concession for the exploitation of the Berlin geothermal resource field to LaGeo, S.A. de CV. The agreement was signed by deed of contract on 28 March 2000. The concession contract establishes the rights and obligations of LaGeo regarding geothermal resource management, establishing a program for implementing the grant in a manner that is sustainable and environmentally, technically and economically sound. The execution program in the concession contract foresaw the increase in generation capacity for the 2002-2004 years. Since 2004, LaGeo has constructed five production wells and four injection wells. In 2006 Unit III, with an installed capacity of 44 MW, was built and in 2007 Unit IV (binary cycle) was constructed with an installed capacity of 9.2 MW.

To develop the Berlin binary project, regulatory filings were made as follows:

- Obtained environmental permits for the “Binary Cycle Assembly for Generating 9.2 MW”, in accordance with Articles 19 and 22 of the Environment Law,^{viii} which was issued by resolution MARN-No-6348-119-2005 dated 15 February 2005 (this process is dependent and interlinked with the permit process with SIGET).
- As part of an expansion to the capacity of a field under concession, a permit application was filed with SIGET, in compliance with Articles 23 of the General Electricity Law and Article 52 of the General Electricity Law Regulation, in order

to assess the impact of performing these works in the operation of the geothermal field.

- The Berlin Binary Cycle project was registered under the Kyoto Protocol to the UNFCCC^{ix} on 30 November 2007, with 235,459 tons of CO₂ to be reduced during the first crediting period (six years), using the methodology ACM0002, ver. 6. The Ministry of Environment and Natural Resources is the entity responsible for approving the Environmental Impact Assessment and Clean Development Mechanism projects. (The third process is independent and the investor must deal with the designated entities. SIGET does not intervene in this process).

Regulatory Coordination with Other Governmental Entities. SIGET's relationship with other entities in El Salvador is one of constant communication and coordination, while respecting the scope of the powers assigned to it by the Act of Creation, by the General Electricity Law and its regulations. In practice, SIGET dedicates considerable communication with the Ministry of Environment, in proceedings related to the concession projects and the consultation process for standards. For the Fiscal Incentives Law, since 2008, SIGET coordinates with the Ministry of Finance on projects seeking certification (not applicable to the Binary Cycle plant, which predates the Fiscal Incentives Law). With the municipal governments, they also carry out consultations of the various operators in the electricity sector, which are addressed in a timely manner.

Through its coordination efforts, adoption of the applicable framework, and its oversight of the application and concession processes, SIGET helps to ensure streamlined and successful implementation of energy projects and to facilitate growth in geothermal energy, a priority of the El Salvadoran Government.

ⁱ *Id.*

ⁱⁱ http://www.ren21.net/pdf/REN21_Report_RETs_for_MDGs.pdf; http://www.energyblueprint.info/fileadmin/media/documents/national/2009/11_gp_e_r__national_india_lr.pdf; Unidad de Transacciones, Statistical Yearbook 2009, page 2, http://216.184.107.60:8080/c/document_library/get_file?folderId=10266&name=DLFE-2807.pdf.

ⁱⁱⁱ ELECTRICITY STATISTICS BULLETIN No. 10, 2008, SIGET.

^{iv} Energy Policy 2007, Electricity Board, Ministry of Economy

^v All the Central American States, except Belize, are located within the Pacific Rim's volcanic zone with large geothermal potential identified as amounting to over 13,000 MW. As of 2009, ten developing countries rank among the top 15 in geothermal electricity production, with four of them in Central America: Costa Rica, El Salvador, Nicaragua and Guatemala. Three (El Salvador, Costa Rica and Nicaragua) are among the top six with the highest share of geothermal power as a percentage of national electricity output. Geothermal production makes sense in Central America from both an environmental and economic standpoint and is likely to grow. See Garcia-Gutierrez, ICS-UNIDO conference presentation, December 2009, <http://www.ics.trieste.it/core-programmes/geothermy/meetings--courses.aspx?itemID=2971>.

^{vi} Feasibility Study for The Optimization and Developments of Ahuachapán, Chipilapa and Cuyanusul Geothermal Systems, LAGEO-ENEL, 15 September 2004.

^{vii} The developer also is obligated to comply with the specific regulations of the municipality where the project is located, as well as institutions that regulate the cutting of trees, use of neighborhood streets and storage of fuels.

^{viii} <http://www.marn.gob.sv/uploaded/content/category/285351936.pdf>

^{ix} <http://cdm.unfccc.int/Projects/DB/DNV-CUK1182851006.68/view>